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(54) **A control pedal unit**

(57) A control pedal unit for a vehicle comprising a support structure (1), a pedal connected to said support structure and means responsive to the movement of the pedal for generating a signal corresponding to the position and/or change of position of the pedal, wherein that the pedal is formed as a resilient body.

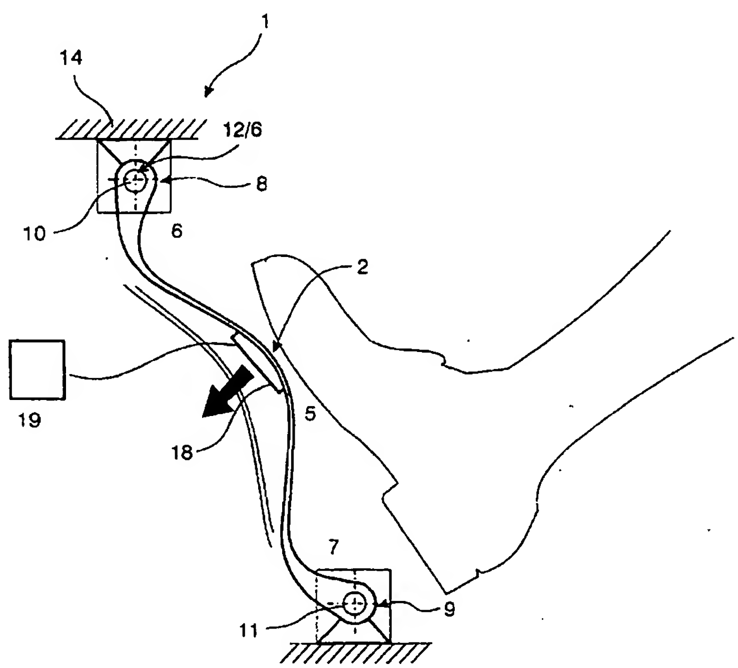

Fig 1

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Description

TECHNICAL FIELD OF INVENTION

[0001] The invention relates to a control pedal unit for a vehicle, such as an accelerator-, brake- or clutch pedal, according to the preamble of claim. In particular the invention relates to a control pedal unit where the need for a separate return means, such as a return spring, for returning the pedal to its unloaded state, is eliminated. More particularly the invention relates to a control pedal unit for a vehicle, which decreases the risk of feet injury in the case of an accident. The invention furthermore relates to a support structure for the purpose of housing at least two control pedal units, a vehicle including a control pedal unit and a method for sensing the position of a control pedal unit.

BACKGROUND ART

[0002] A conventional brake system includes a pivotally hinged lever constituting a pedal. The lever is attached to a push rod, which actuates a piston housed in a master cylinder. The piston is biased by a master cylinder return spring. The master cylinder return spring returns the pedal to its state of rest when a driver releases the pressure on the pedal. Such a system is described in "Vehicle and engine technology", Heinz Heisler pages 235 and 259.

[0003] EP 322 785 relates to an accelerator pedal unit for automotive vehicles incorporating electronic engine management systems, where a pedal position sensor determines the degree of depression of the accelerator pedal. The accelerator pedal unit furthermore includes a return spring to return the pedal to a rest position when released after being depressed by a driver. The object of the invention is to provide, as a safety .measure, means whereby the vehicle automatically breaks down if the return spring breaks.

[0004] US 4009623 relates to a foot lever construction having controlled flexibility. The flexibility is provided for reducing the negative effect when over-exert forces are applied to the lever due to excitement of the driver under racing conditions.

[0005] EP 830 989 relates to a foot pedal linkage where a push rod connected to the pedal arm is provided with a breaking device for, in the event of an accident, releasing the connection between the push rod and the pedal arm. This countermeasure prevents the push rod from, in the case of an accident, pushing the pedal arm further into the compartment, and thereby reduces the risk of feet injury for the driver.

[0006] In DE 43 40 633 a link mechanism retracts the pedals in the case of an accident. This countermeasure reduces the risk of feet injury for the driver, when, in the case of an accident, the driver is forced in the forward direction of the vehicle.

TECHNICAL PROBLEM

[0007] These and a number of other prior art references are all making use of traditional control pedals where a pedal is arranged as a rigid link arm is pivotally attached at a support structure for the pedal. The pedal is returned to its rest position by return springs that act on the lever. The return spring either acts directly or indirectly on the lever. The use of such systems are particularly vulnerable when a position sensor is used for determining wanted acceleration if the spring breaks as indicated in EP 322 785.

[0008] Furthermore, by arranging a control pedal unit as a pedal arranged on a lever that protrude into the compartment of the vehicle, the risk of feet injury is increased for several reasons. If a traditional linkage including push rods is used the pedals might, in the case of an accident, be forced into the compartment with considerable force, thereby resulting in a foot injury of the driver. If a device according to EP 830 989 is used, this risk might be reduced or eliminated, but feet injuries could still occur if a foot of a driver is twisted against the pedal when the driver is forced in the forward direction of the vehicle. A possible result of that the driver is forced in the forward direction while the foot remains on the pedal is that the foot is twisted either backwards or sideways or in both directions. The reason for this twisting is that the pedal does not give adequate support for the foot and that the pedal is protruding into the compartment. Thus there is a possibility that a part of a foot, in the case of an accident, remains on the pedal, while another part is forced forwards without any support.

SUMMARY OF THE INVENTION

[0009] The problems indicated above are solved by providing a control pedal unit according to the characterising portions of claim 1.By providing a control pedal unit where the pedal is formed as a resilient body it is possible to create a pedal unit where the need for a separate return spring is eliminated. The safety is also increased since the dimensions and stability of the pedal eliminates the risk of spring breakage. If an accident should occur when a driver can be forced towards the pedal arrangement the resiliency of the pedal can function as a deceleration unit which decelerates the feet and lower leg portion of the driver under controlled conditions.

[0010] By providing a control pedal unit which includes a support structure which includes a lower support member and an upper support member, according to the characterising portion of claim 2, it is possible to create a pedal that gives a drivers foot full support from the heel to the toes. Furthermore such a construction makes it possible to construct a pedal arrangement where protrusions into the compartment by the pedal arrangement is eliminated. Instead the pedal arrangement will define a continuous curved surface. Such a con-

struction reduces the risk of twisting of the feet in case of an accident.

[0011] By providing a control pedal unit where the resilient body is pivotally attached to a support structure s suggested in claims 3 and 4 it is possible to create a pedal with sufficient resiliency while having a reduced total length of the pedal, which is advantageous due to the lack of space in the feet region of a vehicle.

[0012] By providing a control pedal unit where the resilient body is rigidly attached a the support unit as suggested in claims 5 and 6, it is possible to create a resilient pedal, supported only at one end. Such a pedal might be given an appearance that reminds of a traditional pedal, while it still will have the benefit of being resilient which, in the case of an accident, will reduce the risk for feet injury.

[0013] By providing a curved resilient body having at least one bulge facing in the direction of a driver when mounted in a vehicle, as suggested in claim 7, it is possible to create a pedal unit which has an adequate flexure under load.

[0014] By providing a symmetrical flexible link as suggested in claim 8 it is possible to create a pedal unit where the bulge of the resilient body performs a linear displacement perpendicular to a plane including the points where the flexible body is attached to the support structure.

[0015] By making the resilient body with one bulge as suggested in claim 9, one obtains the advantages of symmetry while maintaining a simple and appealing structure.

[0016] By making the flexible link where the flexure of the link increases with increasing load, as claimed in claim 10, a stable structure is created where a driver is not surprised by the behaviour of the pedal.

[0017] The arrangement as claimed in claims 7 to 10 provides for an ergonomic pedal function for a driver.

[0018] The use of a resilient body for making a pedal structure is particularly suited when using a strain gage, as claimed in claim 11, as means for measuring or indicating the pedal position. If a normal pedal arrangement is used, the pedal position cannot be directly indicated by a strain gage. Instead the pedal must be arranged to bend a separate body, which degree of flexure can be measured by a strain gage. The use of the resilient body together with a strain gage renders possible a simple, reliable pedal structure, including the benefits of the resiliency in a crash situation.

[0019] Other advantageous embodiments of the means responsive to the flexure of the pedal are claimed in claims 12 to 16.

[0020] By providing a support structure for the purpose of housing at least two control pedal units as claimed in claim 17 a functional unit including the benefits of the use of a flexible body as a pedal is created.

[0021] By positioning the at least two pedals so that a continuous surface is created, as claimed in claim 18, the risk for sideways twist of the feet of a driver is reduced in case of an accident.

[0022] By providing means for preventing access underneath the continuous surface when a pedal is depressed, as claimed in claims 19 to 21 the behaviour in an accident situation is further improved.

[0023] A structure according to claims 22 and 23 provides for a pedal structure which easily could be adapted to drivers of different length, thereby reducing the need for a short driver to be positioned in an excessively low position, which could be detrimental to sight conditions for a short driver.

[0024] Claims 24 and 25 relates to a vehicle incorporating a pedal unit provided with a pedal formed as a resilient body and a vehicle including a support structure including such a pedal.

[0025] Claims 26 and 27 relates to alternative embodiments of claim 1.

[0026] Claim 28 relates to a method of sensing the position of a pedal including a resilient body wherein a signal is generated which corresponds to the flexure of the pedal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The invention will be described in greater detail below, with references to the appended drawings, in which

Fig. 1 is a side view of a control pedal unit,

fig. 2 is a perspective view of a pedal cluster including three pedal units,

fig 3 is a perspective view of a support structure including three pedal units, where the support structure is mounted in a frame,

fig 4 is a side view of a pedal including a side wall for preventing access to the region underneath a neighbouring pedal when depressed by a driver,

fig 5a - 5f are side views of pedal units having different means for detection of the degree of flexure of the pedal,

fig 6a -6b are side views of pedal units having add on ergonomic comfort features and

fig 7 is a side view of a pedal unit mounted in a frame having means for adjusting the position of said pedal.

PREFERRED EMBODIMENTS

[0028] Fig 1 shows a side view of a control pedal unit for a vehicle comprising a support structure 1, a pedal 2 connected to said support structure 1 and means 3 responsive to the movement of the pedal 2 for generat-

ing a signal corresponding to the position and/or change of position of the pedal.

[0029] The pedal 2 is formed as a resilient body. The body is essentially a shaped resilient surface having a width dimension and a length dimension which are considerably larger than the thickness of the body. As shown in the side view, the surface is curved and has a mid portion 5, and a first end portion 6 and a second end portion 7. Means 8, 9 for securing the surface to the support structure 1 are provided at the first 6 and second 7 end portions. In a preferred embodiment said means are constituted by a pin 10,11 that protrudes through a hole at said first 6 and second 7 end portions of the surface. Thereby the surface is pivotally arranged at both end portions, thereby giving the surface reduced resistance to bending while maintaining the thickness of the surface.

[0030] Due to the fact that the surface is curved it possesses a bulge or a number of bulges. The surface in fig 1 has one bulge facing the direction of a driver, when mounted in a vehicle. The bulge is essentially distributed over the mid portion 5 of the surface. By placing the bulge centrally between said means for securing 8,9 the surface and making the surface symmetrical the mid portion 5 of the pedal surface will undergo a linear motion transverse to a plane passing through the securing means 8,9.

[0031] From a top view over the surface, see fig 4, the surface has a rectangular shape. A preferable width is preferably ranging from 12 - 16 cm. The length,size and shape of the surface is adapted for positioning said bulge situated in the mid portion of the surface in a comfortable position beneath the sole of a driver with normal sized shoes, when held in a correct position. The length is also adapted for giving the surface the correct resiliency. The length of the surface is preferably ranging from 25 - 45 cm.

[0032] The thickness of the surface is adapted to give the surface an adequate resiliency, while making the surface sufficient sturdy to endure repetitive flexing under the life span of the vehicle. The thickness of the surface is preferably ranging from 1 - 5 mm. The pedal surface may have corrugations to increase the flexibility.

[0033] The surface is preferable made of a plastic material which might be reinforced by fibres.
The material should have sufficient fatigue strength to withstand repeated pedal applications during its intended lifetime. Typical materials would be acetal polymers with Young's moduli in the range of1 GPa to 7 GPa.

[0034] In the end portions of the surface bores 12, 13 are provided for housing pivots 10,11. The surface might be reinforced in the region of said bores, either by the inclusion of reinforcement fibres or by making the surface thicker in this area.

[0035] The surface is supported by the support structure 1 The support structure includes an upper support member 4 and a lower support member 5. The upper and lower support structures 4,5 each houses retaining means 14,15 adapted to carry respective pivots 10,11. The retaining means 14,15 are formed as flanges including bores 16,17. When mounting the surface to the support structure the surface is positioned in the support structure with the bores of the surface aligning the bores of the flanges. The pivots 10,1 lare then inserted through said bores and secured to the flanges 16,17. The pivots can be secured in any conventional way, for instance by forming the pivots as bolts, which are secured by a nut when mounted in a bracket formed by the flanges 14,15.

[0036] In an alternative embodiment the surface is shaped with snap locks in the end regions. Providing a bore, which is partly open, along the length of the bore, makes such a snap lock. The width of the opening is less than the diameter of the pivot. The surface can be forced on the pivot.

[0037] The surface is furthermore provided with means 3 responsive to the movement of the pedal 2 for generating a signal corresponding to the position and/or change of position of the pedal. In fig 1 said means includes a strain gage 18 that is mounted on the surface. The strain gage 18 generates a signal that is dependent on the amount of flexure of the pedal. The signal is processed by a processor 19 which controls a chosen function of the vehicle such as the brake system, the required power output of the engine or any other system controllable through a pedal.

[0038] The support structure is preferable made as a support frame as shown in fig 2. Fig 2 further indicates a cluster of 3 pedals 20, 21, 22. The pedals are intended to function as an accelerator pedal, a break pedal and a clutch pedal. The cluster of pedals are housed in a support structure 1 shaped as a support frame. The support frame 1 includes a top wall 23, two side walls 24, 25 and a bottom wall 26. Said walls are connected together forming a closed box shaped structure. If extra rigidity as required a back wall could be added leaving only a front opening of the box shaped structure. Two pivots 10,11 are arranged and secured to the side walls 24,25. The pivots carries said three pedals 20, 21, 22. The pivots together with the box shaped structure create a very rigid frame that protects the feet in case of a side collision. The box, when mounted in a vehicle, could be connected to the frame structure at both sides of the vehicle via a stiff structure, thereby increasing the side impact protection of the vehicle.

[0039] A first pivot 10 is arranged in the upper part of the support structure 1 forming the upper support member 4 and a second pivot is arranged in the lower part of the support structure forming the lower support member 5. The first pivot 10 is arranged in a back portion 27 of the support structure 1 and the second pivot 11 is arranged in a front portion 28 of the support structure 1. This arrangement provides for an inclination of the pedal in relation to the box shaped support structure 1. When mounted in a vehicle, the fixation of the box shaped support structure 1 and the inclination of the pedal within the support structure is chosen so that an inclination an-

gle a in relation to a horizontal plane in the vehicle is preferably in the range of 15°-60°.

[0040] As shown in the figure the three pedals together forms a surface without large gaps and any protruding elements as a traditional set of pedals would do. In an alternative embodiment a separating member can separate neighbouring pedal units. In that case the pedal units together with the separating member create a surface without any large gaps. The separating member can be made in the same fashion as the resilient body of a pedal unit with the only difference that the separating member is not provided with any means for generating a signal in dependence of the flexure of the separating member. In preferred embodiments the separating member has a similar or the same curvature as the pedals.

[0041] In a preferred embodiment the separating member is formed with a resistance to flexure that is greater than the resistance to flexure of the neighbouring pedals. This reduces the risk for a driver to push the separating member in stead of a pedal by mistake. If the separating member is provided with an enforcing structure that deforms under the load that would occur under a collision a structure which prevents the driver from erroneously pushing the separating member while still having the benefits of resiliency would be created.

[0042] Fig 3 shows a perspective view of a pedal frame together with two pedals mounted in a vehicle. The width of the pedal frame is so chosen that the pedal frame fills the complete space between an outer wall 30 of the vehicle and the tunnel 31 separating the drivers feet compartment from a passengers feet compartment. This increases the rigidity of the vehicle and thereby the side impact safety, and eliminates gaps large enough for feet to slide into.

[0043] Fig 4 shows a side view of a pedal surface having a side portion 40 for preventing access underneath a pedal when a neighbouring pedal is depressed. The side portion can be made of elastomeric or foam material that is attached to the backside of the surface. It can also be constituted by an open comb filler. If a separating member is used means for preventing access under the pedals are preferably provided on the separating member.

[0044] Fig 5 a-f show different embodiments of means for generating a signal corresponding to the degree of flexure of the pedal. Fig 5a show a linkage 51 that is connected to the resilient surface. When the surface is actuated the link will follow the movement of the point 52 of the surface where the link 51 is attached to the surface. Fig 5b show a cam 53 that is mounted for following the movement of the surface. The motion of the cam can be measured by a rotational sensor 54. The cam may constitute a conventional brake, clutch or accelerator lever arm, in which case the resilient pedal surface serves as a protective cover over a conventional pedal assembly. Fig 5c show a cable 55, which is, attached at an upper portion 56 of the surface and a lower portion 56 the surface. When the surface is actuated the distance between the points of connection of the cable is changed. Thereby the cable can function as means for generating a signal that corresponds to the degree of flexure of the surface. Fig 5d shows a strain gage 57 attached to the surface. When the surface flexes a signal is generated that corresponds to the degree of flexure of the surface. Fig 5e shows a rotary sensor 58 attached in the vicinity of a pivot 59 of the resilient surface. When the surface is actuated the portion around the pivot will rotate, whereby the rotary sensor will functions as means for generating a signal that corresponds to the degree of flexure of the surface. Fig 5f shows a linear sensor that is attached and functions in the same manner as the cable as shown in fig 5c.

[0045] In fig 6 a pedal surface is shown, which carries two variants of ergonomic add on comfort features 60.

[0046] As shown in fig 7 it is possible to arrange the pedal units movable within a frame so that the position of the pedal can be adapted to the height of the driver. This can be accomplished by mounting the upper and lower members 61, 62 of the support structure to worm screws 63 and 64. The two screws can be driven individually or by a belt 65,which in turn is rotated manually or by a motor. The belt gives the two screw equal rotational velocity, thereby making is possible to move the pedal along the axis of said screws. The entire frame could also be rotated about a revolute joint positioned above the frame thus adjusting pedal proximity to the driver.

[0047] The invention is not limited to the above-mentioned embodiment, but may be varied within the scope of the claims. For example the resilient body might be supported only at one of its ends having the other end free. Such a pedal would remind more of a traditional pedal. However, the principle of generating a signal that corresponds to the flexure of the pedal would remain. If such a pedal is used the resilient body must be rigidly attached at the supported end. Furthermore a pedal unit could be arranged where one end is rigidly or pivotally supported while the other end is resting on a support. Other material than plastic could create the resilient member, for instance in spring steel or it could be made of segments containing rigid and resilient material in combination. All the embodiments of the invention could be provided with a compliant travel stop, which may be incorporated under the flexible element to withstand high pedal loads that are beyond the load bearing capacity of the flexible element alone.

Claims

1. A control pedal unit for a vehicle comprising a support structure (1), a pedal connected to said support structure and means responsive to the movement of the pedal for generating a signal corresponding to the position and/or change of position of the ped-

al, characterised in that the pedal is formed as a resilient body supported by said support structure and that said means responsive to the movement of the pedal are arranged for generating a signal corresponding to the degree of flexure and/or change of flexure of the pedal.

2. A control pedal unit for a vehicle according to claim 1 characterised in that the support structure (1) includes an upper support member (2) and a lower support member (3) and that the resilient body is supported by said upper and lower support members whereby the resilient body is arranged to flex under load between said upper and lower support members.

3. A control pedal unit according to claim 2 characterised in that the resilient body is pivotally attached at the upper support member.

4. A control pedal unit according to claims 2 or 3 characterised in that the resilient body is pivotally attached at the lower support member.

5. A control pedal unit according to claims 1 or 2 characterised in that the resilient body is rigidly attached at the upper support member.

6. A control pedal unit according to claim 1, 2, 3 or 5 characterised in that the resilient body is rigidly attached at the lower support member.

7. A control pedal unit according to any of the preceding claims characterised in that the resilient body is curved, whereby at least one bulge is facing, when mounted in a vehicle, in the direction towards the driver.

8. A control pedal unit according to claim 7 characterised in that the resilient body is symmetrical with respect to said bulge.

9. A control pedal unit according to claim 7 or 8 characterised in that resilient body has one bulge.

10. A control pedal unit according to any of the preceding claims characterised in that the flexure of the resilient body increases with increasing load.

11. A control pedal unit according to any of the preceding claims characterised in that the means responsive to the movement of the pedal includes a strain gage which is attached to the resilient body, whereby the corresponding degree of flexure is measured by the strain gage.

12. A control pedal unit according claims 3 or 4 characterised in that the means responsive to the movement of the pedal includes a rotary sensor which is attached to the resilient body, preferably in the vicinity of a pivoting connection between the resilient body and the support structure, whereby depression of the resilient body pivots the resilient body in the region of the pivoting connection.

13. A control pedal unit according to any of the preceding claims characterised in that the means responsive to the movement of the pedal includes a linear sensor attached to the resilient body at two distant locations, whereby flexure of the resilient body increases the distance between said two distant locations.

14. A control pedal unit according to any of the preceding claims characterised in that the means responsive to the movement of the pedal includes a cable attached to the resilient body at two distant locations, whereby flexure of the resilient body increases the distance between said two distant locations.

15. A control pedal unit according to any of the preceding claims characterised in that the means responsive to the movement of the pedal includes a cam member, whereby the cam member follows the flexure of the resilient body.

16. A control pedal unit according to any of the preceding claims characterised in that means responsive to the movement of the pedal includes a link mechanism which is attached to the resilient body

17. A support structure for the purpose of housing at least two control pedal units according to any of the preceding claims.

18. A support structure according to claim 17 characterised in that, the at least two pedals, when not depressed by the driver, together forms a continuous surface.

19. A support structure according to claim 18 characterised in that each pedal is separated by a separating member having a surface, when mounted in a vehicle facing in the direction of the driver, that has the same shape as the corresponding surface of the pedals, said separating member forming a continuous surface together with the pedals when the pedals are not depressed by the driver.

20. A support structure according to claim 19 characterised in that the separating member has side portions preventing access underneath the continuous surface when a neighbouring pedal is depressed.

21. A support structure according to claim 17 characterised in that at least two pedals are neighbouring

each other and that each pedal neighbouring another pedal has a side portion facing the neighbouring pedal, said side portion preventing access underneath the continuous surface when a neighbouring pedal is depressed.

22. A support structure according to any of claims 17-21 characterised in that the support structure is mounted in a pedal frame, said pedal frame fills the space between a side structure and a tunnel wall of a vehicle thereby creating a complete surface without protrusions in the feet region of a driver.

23. A support structure according to claim 22 characterised in that the support structure is adjustably supported by the frame whereby the positions of the pedals can be adjusted to the length of the driver.

24. A vehicle comprising a propulsion unit, at least one control pedal unit for the propulsion unit, a break system which is adapted to decelerate said vehicle or hold the vehicle in a stand still position and a break control system for controlling the applied breaking force on said vehicle, wherein said brake control system is connected to a break pedal characterised in that at least one of said pedals are formed as a control pedal unit according to any of the preceding claims 1-16

25. A vehicle according to claim 24 characterised in that said accelerator pedal and said brake pedal are arranged in a support structure according to any of claims 17 to 23.

26. A control pedal unit for a vehicle comprising a support structure (1), a pedal connected to said support structure and means for generating a signal corresponding to the position and/or change of position of the pedal, characterised in that the pedal is formed as a resilient body supported by said support structure and that said means are arranged for generating a signal corresponding to the degree of flexure and/or change of flexure of the pedal.

27. A control pedal unit for a vehicle comprising a support structure (1) and a pedal connected to said support structure characterised in that the pedal is formed as a resilient body supported by said support structure and that means responsive to the flexure of the pedal are arranged for generating a signal corresponding to the degree of flexure of the pedal.

28. A method of sensing a position of a control pedal unit for a vehicle wherein the pedal formed as a resilient body characterised in that a signal is generated which corresponds to the degree of flexure of the pedal.

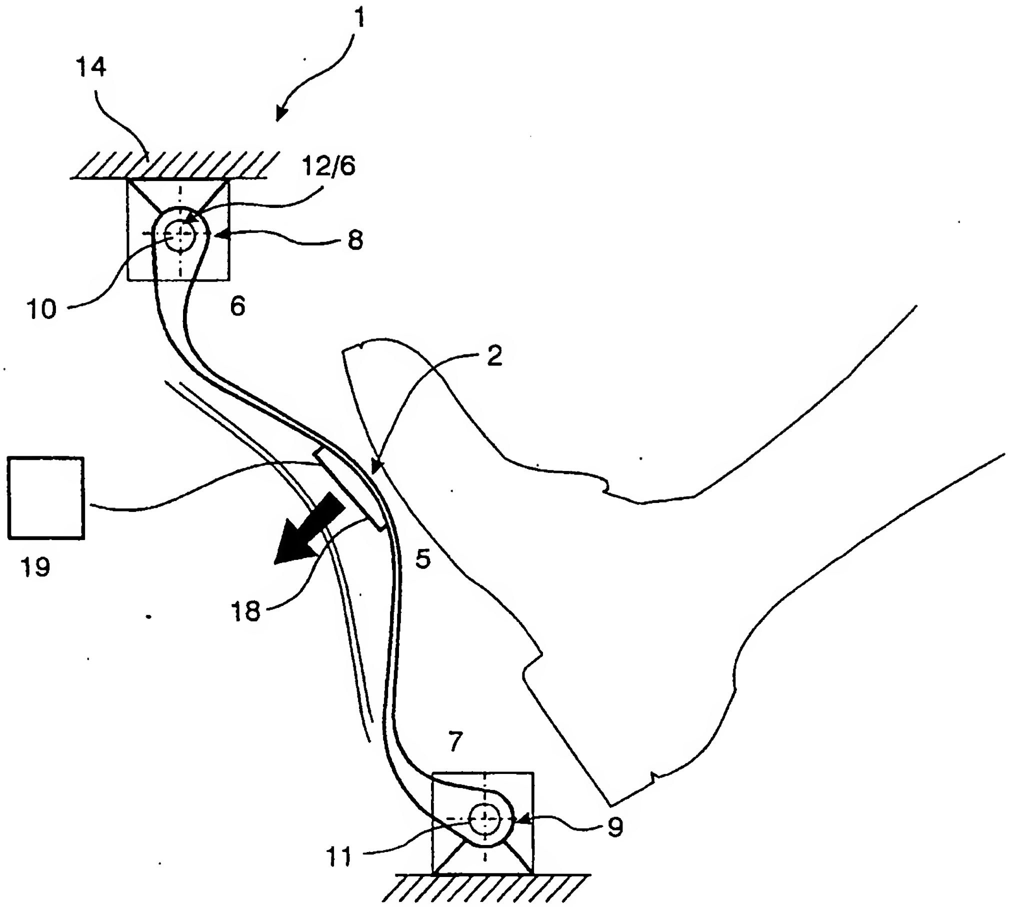


Fig 1

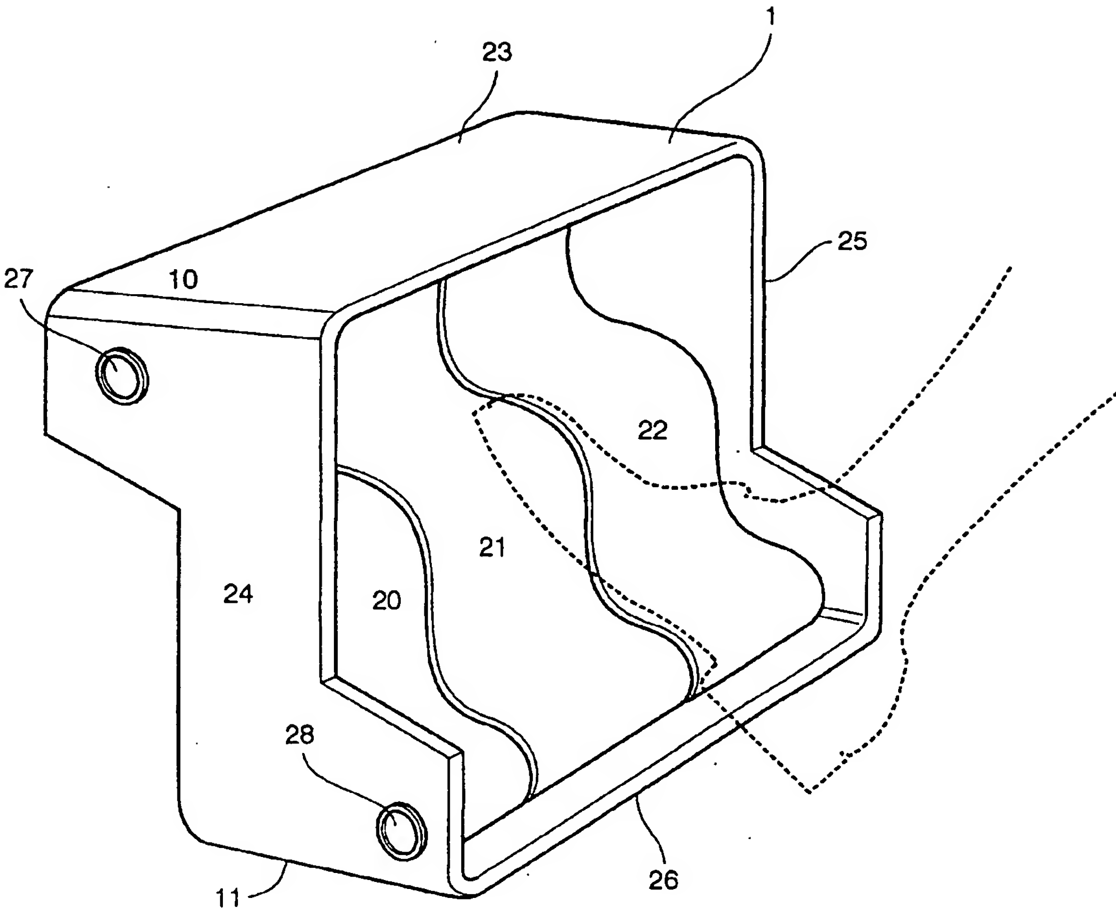


Fig 2

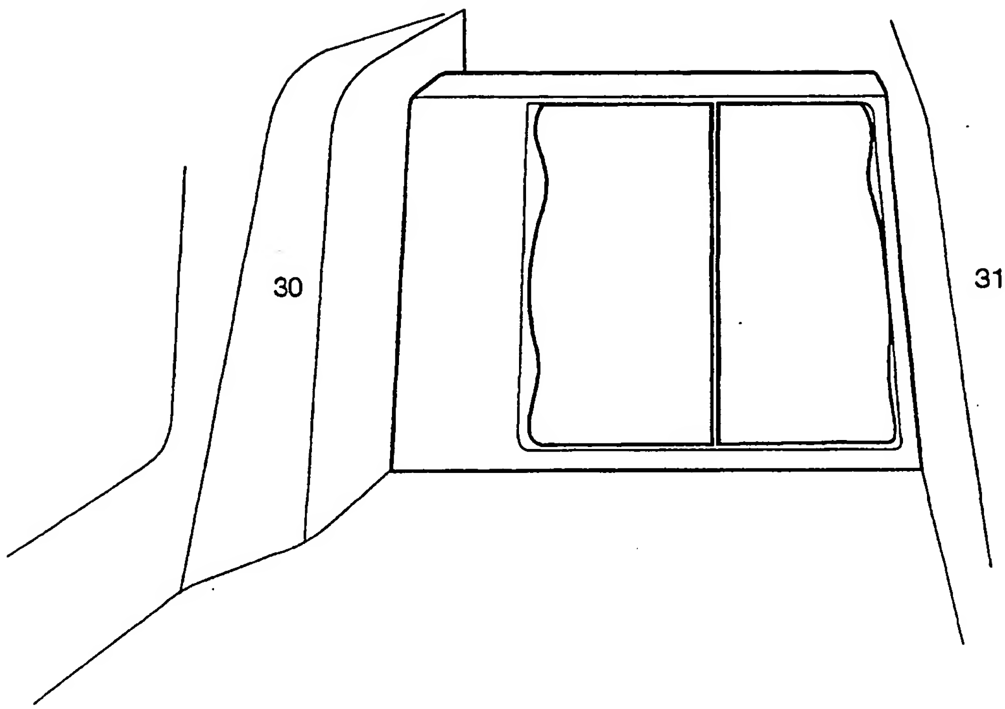


Fig 3

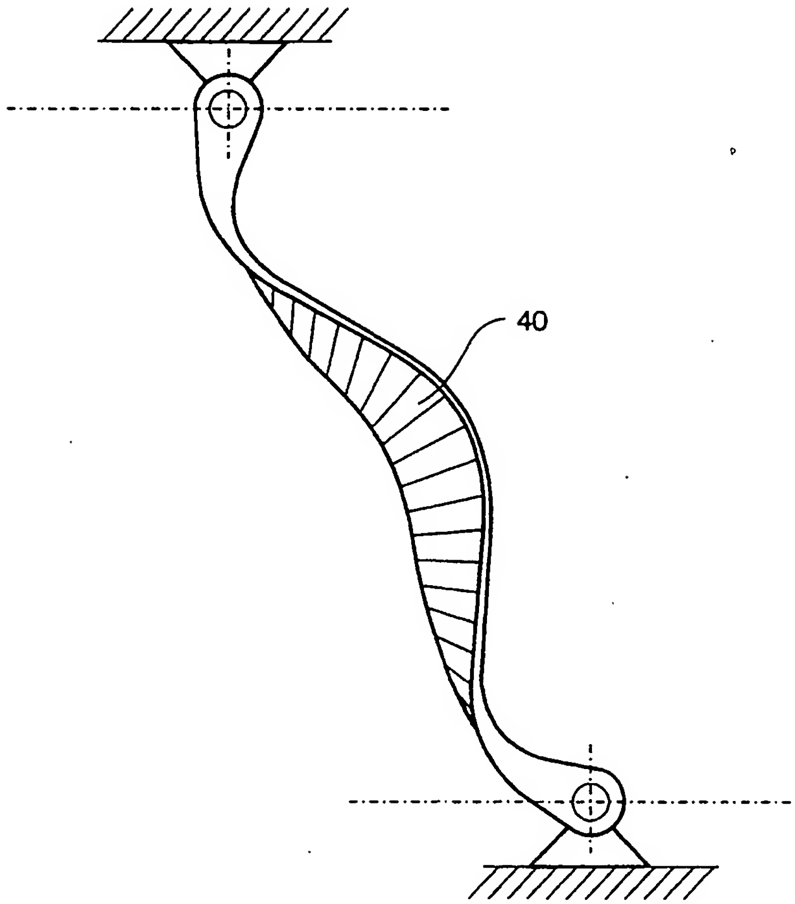


Fig 4

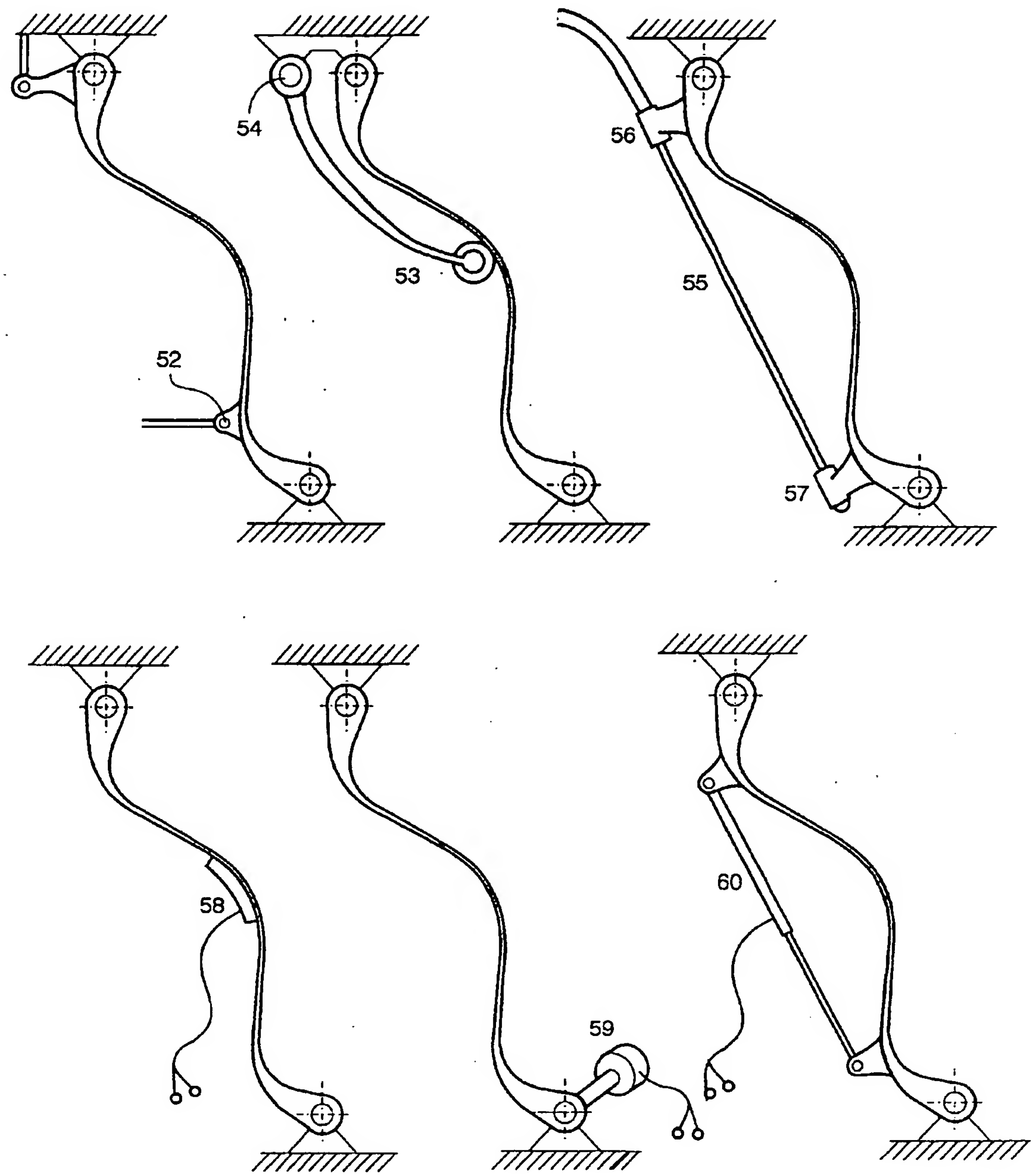
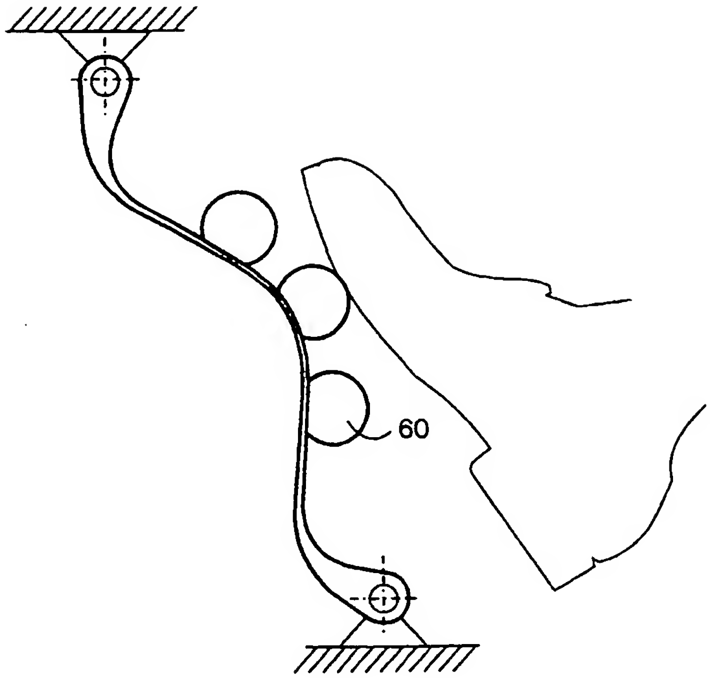


Fig 5



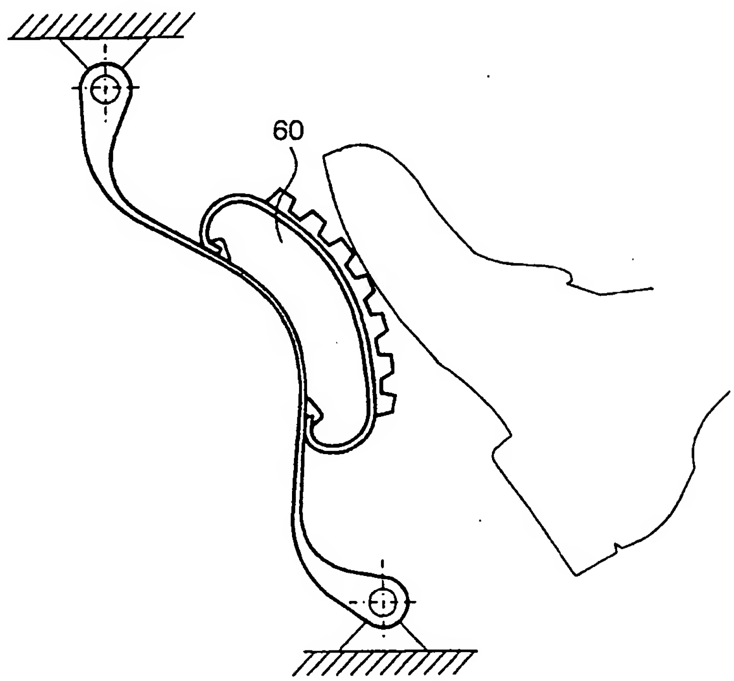


Fig 6

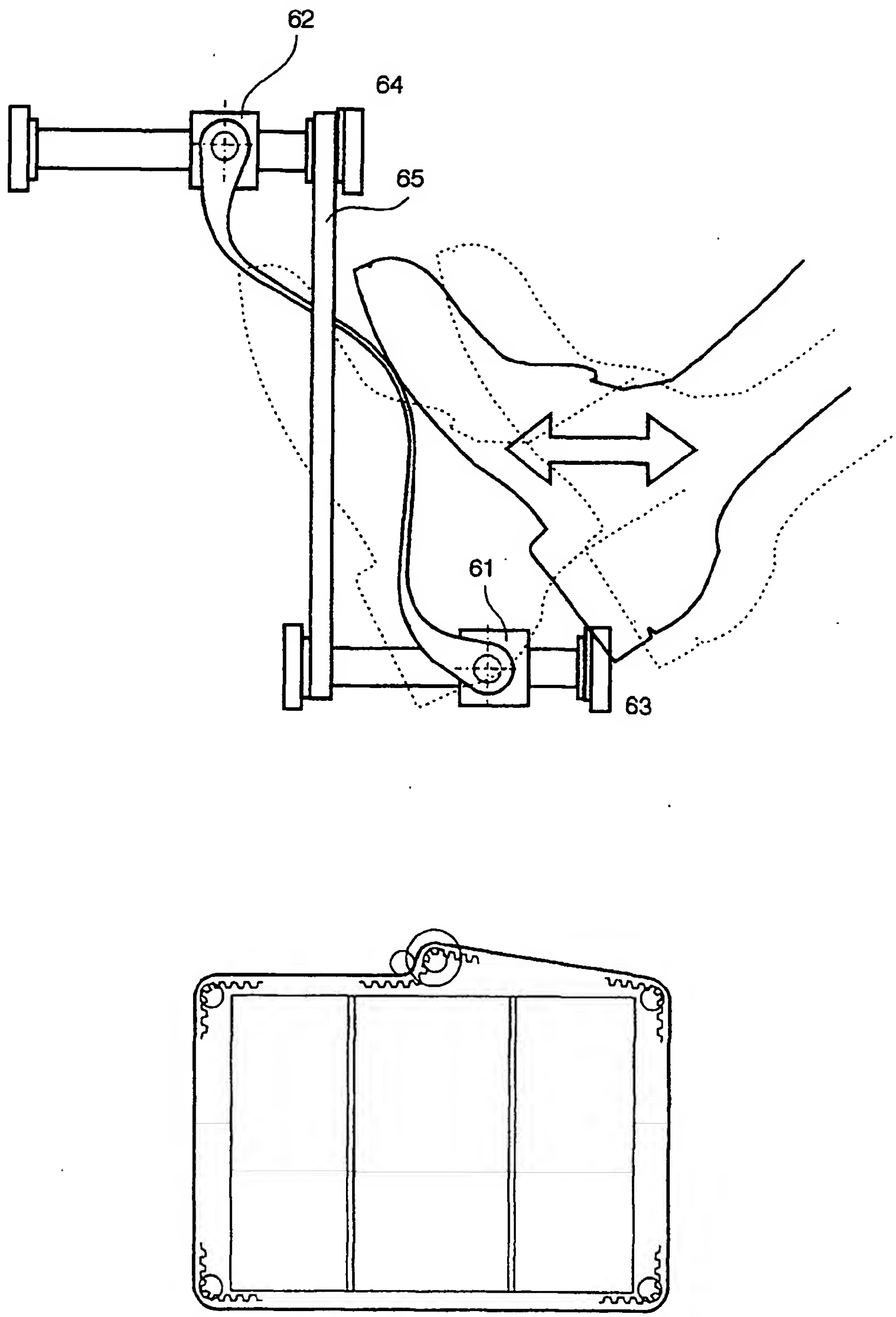


Fig 7

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